The evaluation of argument mapping as a learning tool: Comparing the effects of map reading versus text reading on comprehension and recall of arguments

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ABSTRACT

The current study compared the effects on comprehension and memory of learning via text versus learning via argument map. Argument mapping is a method of diagrammatic representation of arguments designed to simplify the reading of an argument structure and allow for easy assimilation of core propositions and relations. In the current study, 400 undergraduate volunteers were presented with a colour map, black-and-white map, or text version of a large (50 bit) or small (30 bit) argument that centred on the question: can computers think? Argument comprehension and memory was tested immediately after a 10 min study period. Results indicated that participants who studied the argument maps scored higher than those who studied text, on tests of memory, though not comprehension, and that participants had more difficulty assimilating the large (50 bit) argument in the time allotted. Results are discussed in light of research and theory on human learning and memory.

1. Introduction

The purpose of educational text material is to be read and understood. In addition, in educational contexts, the material must often be memorized as well. Memory is classically conceptualized as involving short and long term components (Squire, 1987). Short-term (or working) memory is a region of limited capacity that enables manipulation of whatever information is currently present to it (Baddeley, 1986), while long-term memory is a region that enables long-term information storage. In order for information to be memorized, it must pass from short-term to long-term memory (Craik, 1983). This is referred to as encoding. For example, when reading a passage of text, short-term (or working) memory stores the words and sentences currently being scanned, and efforts to process the meaning of the text facilitate long-term storage and learning by building lasting representations of the information (Craik & Lockhart, 1972). However, for lengthy pieces of text, learning can be difficult because the creation of an integrated representation in long-term memory is constrained by the storage limitations of working memory (Cowan, 2000; Miller, 1956).

It has long been argued that the way in which information is manipulated in short-term memory during the encoding process is critical for later recall (cf. Shimmerlik, 1978). Organizational strategies during encoding account for one such set of manipulations. Organizational strategies are believed to be beneficial in the sense that they provide a retrieval scheme that facilitates recall. For example, by 'chunking' related bits of information, recall of one part of a chunk aids retrieval of other parts of the same chunk, thus serving as a retrieval cue (Miller, 1956; Shimmerlik, 1978).

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1.1. Organizational strategies

Various organizational strategies have been devised to enhance long-term retention of information, including, for example, summarisation (Kintsch & van Dijk, 1978; Wormeli, 2004), drawing inferences, generating questions, monitoring for understanding (Dole, Duffy, Roehler, & Pearson, 1991), constructing representational imagery (Paivio, 1990; Pierce, 1980), and hierarchical summarisation (Taylor, 1982; Wade-Stein & Kintsch, 2004). The bulk of research on organization and memory has examined story memory, and in this regard, evidence suggests that when to-be-remembered story events are presented in a well-organized manner, the level of free recall is better than when the events are presented in a random order (Bower, Clark, Lesgold, & Winzenz, 1969; Myers, 1974). Also, readers who are sensitive to text structure recall more information than readers who are not (Meyer, Brandt, & Bluth, 1980).

Some researchers have suggested that because it is too memory intensive to remember everything from a passage of text, a macrostructure, or the 'gist' of the text, is stored in long-term memory, and this represents the summary information a reader considers important (Kintsch & van Dijk, 1978). Hence, it is this macrostructure, and not the original text that the reader remembers when later asked to recall the text (Kintsch & van Dijk, 1978). The problem with this learning strategy is that although the formulation of a macrostructure presumably facilitates recall of information, it is likely that information is not encoded at a very deep level of specificity; in other words, the detail of propositions and of relations between propositions will probably not be remembered.

Hierarchical summarisation is a more explicit, active organizational strategy than learning the gist of a text. It involves extracting and summarising the key themes and sub-themes in a text. Taylor (1982) found that the use of hierarchical summarisation increased recall of text in students who were trained in the use of the technique. A similar study by Berkowitz (1986) provides a rare example of how organizational strategies can be used to facilitate learning of prose arguments. Berkowitz taught students to construct maps of prose passages. Using this mapping strategy, the main ideas from the passages were summarised in separate boxes and supporting claims were listed as bullet points beneath each of the main ideas. The boxes were organized in a radial structure (i.e., around a central claim). Berkowitz found that for students who used this technique overall recall of passages was significantly improved relative to students who used traditional study techniques (i.e., question-answering and re-reading procedures).

Although Berkowitz described her maps as a graphic representation of the super-ordinate and some of the more important sub-ordinate ideas in a passage, organized in a manner similar to the way the author organized them in the original selection, the propositional content of the radial maps did not represent fully planned arguments. Also, although Berkowitz attempted to construct maps that corresponded to the way the author organized ideas in the original selection, the radial structures in no way reflected the structure of the argument (see Twardy, 2004 for a discussion of the text to argument map translation process). Finally, Berkowitz provided extensive training to students in the use of the mapping technique. Although training in the use of organization techniques and active manipulation of arguments is a crucial part of learning (Van Gelder, Bissett, & Cumming, 2004), a critical question is whether or not more explicit, complete, logical, hierarchically structured argument maps that faithfully represent the structure of an argument can be packaged as an optimal method of *presenting* information to students who are asked to read, understand, and remember.

1.2. Building a mental representation of an argument

When it comes to analysing arguments, the problem with traditional text-based learning is that it does not allow one to readily connect statements that support and dispute specific reasons. The learner must engage in a cognitively demanding process of linking propositions that are located in different paragraphs, on different pages, and so on. When reading a text-based argument, the reader must mentally construct the argument, thus switching attention away from the information presented in the text. In a series of seminal studies, Pollock, Chandler, and Sweller (2002) found that learning is impeded when instructional materials require a high degree of attention switching, for example, between text and figures. They concluded, more generally, that encoding environments that increase the cognitive burden (or load) placed on the reader tend not only to slow the learning process, but also reduce overall levels of learning. It is an untested assumption, but, presumably, the provision of a good visual representation of an argument structure will reduce the cognitive burden associated with conjointly reading and mentally representing the structure of an argument. The provision of this critical organizational, structural information should in turn facilitate argument comprehension and memory.

1.3. Argument mapping

An argument map organizes the arguments in a text into a hierarchical representation, often pyramid-shaped, with propositions arranged in coloured boxes and connected by arrows that highlight relations between propositions (Van Gelder, 2002). Having available the structure of an argument is crucial for many reasons; it facilitates logical reasoning, the ready construction of a 'mental image' of the whole argument, and the answering of specific questions about the relation between one proposition and others. Theoretically at least, representation of an argument using an argument map should remove obstacles to learning related to the need to simultaneously read the text of an argument and mentally visualize the relational structure of the argument being presented. However, there has been very little research into argument mapping as a